

Sibling Rivalries

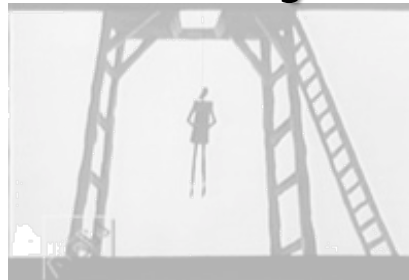
Reconciling Systems and Software Engineering

Richard Turner

Stevens Institute of Technology
rtuner@stevens.edu

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Heresy?



- ◆ From Greek word *hairetikos* "able to choose" or "to pick and choose"
- ◆ Good engineering is about "picking and choosing" the right approaches
- ◆ I stand by my heresy!

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Changes: Problems or opportunities?



Growing Complexity

- ◆ Number of interoperating components/systems
- ◆ Connectivity and interdependencies
- ◆ Adaptation and emergent behavior
- ◆ Impact of technical, social, political, economic, behavioral and environmental implications ...
- ◆ Decrease in central control & reliability of subsystems and services

Collaboration

- ◆ **Fundamentally changing how systems are conceived, developed, deployed, and managed**
- ◆ **Increasing need for holistic development and deployment environments**
- ◆ **Redefining society in a collaborative, distributed, evolvable manner.**
- ◆ **Expanding serious use of social networking sites and virtual environments**

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Increasing Criticality

- ◆ **Systems are no longer a matter of convenience, but necessary for daily existence**

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Tenuous Security

- ◆ Security is paramount (at least in some places)
- ◆ Increasing criticality increases target value
- ◆ Increasing complexity and interconnectedness increases vulnerability.
- ◆ Security of enterprises composed of unreliable and independently evolving systems
- ◆ Legacy, COTS, open source and other software of unknown provenance are systems issues

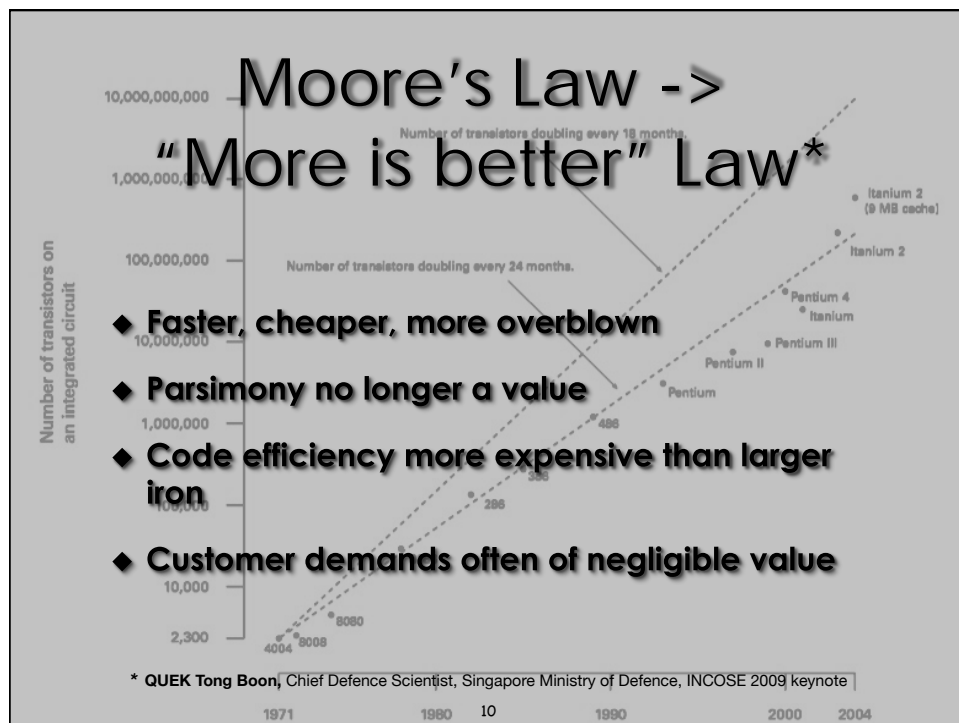
Compressed Time

- ◆ Compressed notion of time based on relative change
- ◆ Customer expectations and competitive demands shorten lifecycles
- ◆ Customizable interfaces and mashing give users instant gratification
- ◆ Decisions made with possibly more data but often less analysis

Evolved Workforce

- ◆ Born networked in a rapidly changing problem and solution space
- ◆ Nurtured with instantaneous feedback
- ◆ Increasingly more action oriented
- ◆ Less trusting of extensive analysis

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Ascendancy of SW

- ◆ Capability and malleability are great enablers
- ◆ Majority of functionality now dependent on SW
- ◆ Intensifies risk and elevates quality issues

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Interdependent Systems

- ◆ Evolution of Systems
- ◆ A "major" portion of the capabilities/value is delivered through software
- ◆ A "major" portion of quality attributes (safety, security, agility, reliability, ...) "largely" depend on software

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Fred Brooks' prowling werewolves

Invisibility
Complexity
Conformity
Changeability

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Silver bullet, anyone?

- ◆ The software werewolves still bite the unsuspecting
- ◆ With interdependent systems they are growing stronger and their prey is multiplying
- ◆ But SE/SwE integration may at least provide some lead bullets
- ◆ But there is a problem... ***SIBLING RIVALRY!***

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Why are SE and SwE siblings?

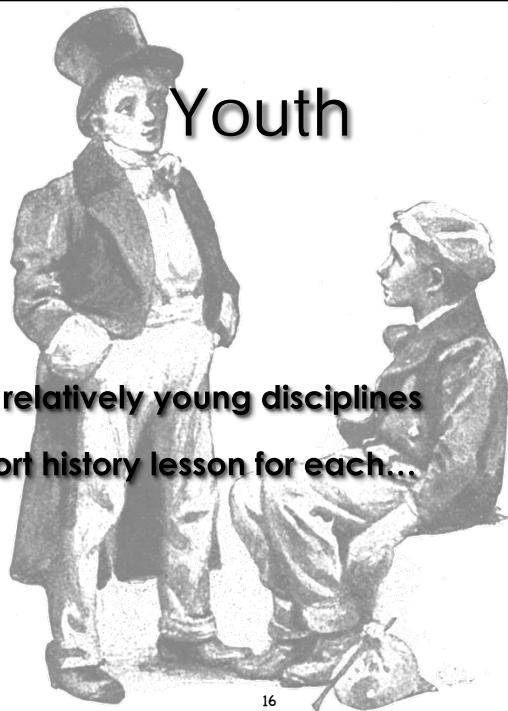


- ◆ Youth (age?)
- ◆ Identity
- ◆ Practicality
- ◆ Respect (not!)

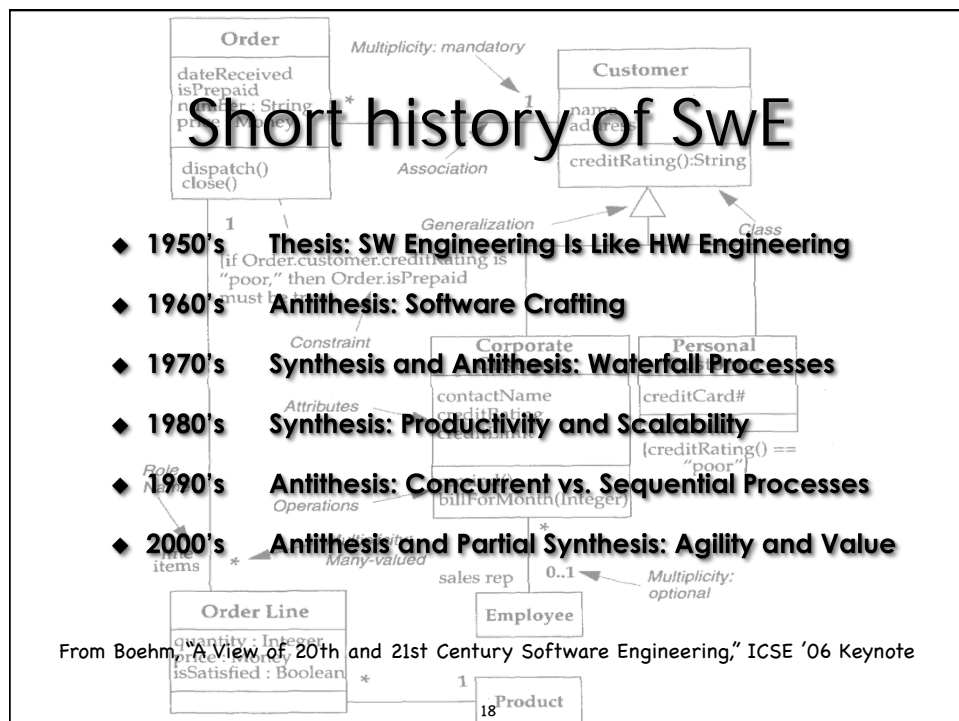
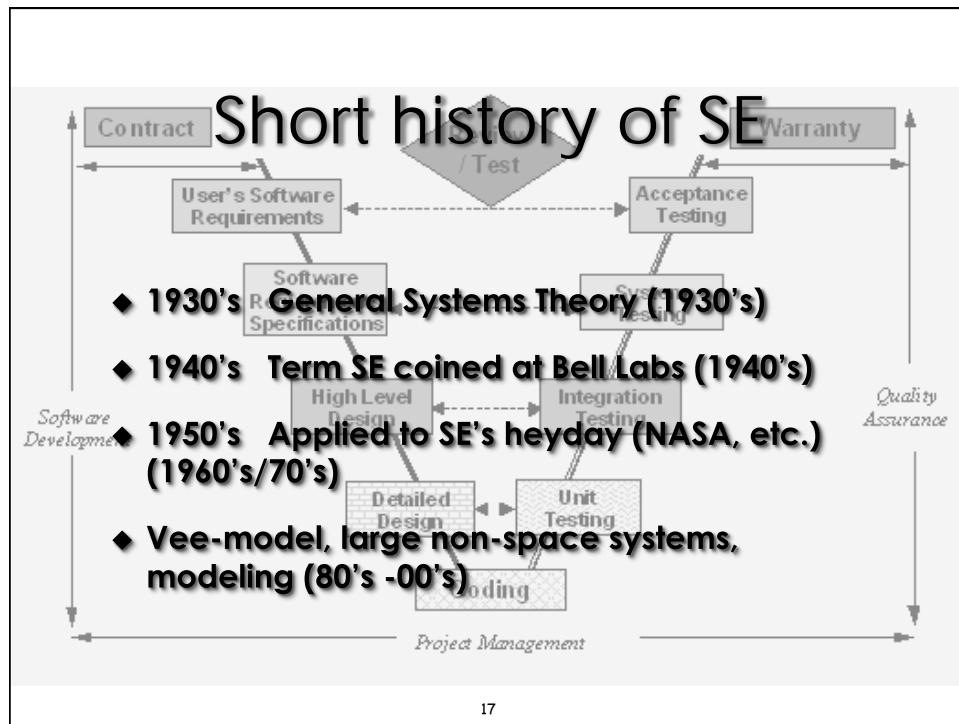
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Youth

- ◆ Both relatively young disciplines
- ◆ A short history lesson for each...



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Identity

◆ Challenge:

- ◆ Find a single accepted, authoritative and meaningful definition of systems or software engineering
- ◆ Find two software or systems engineers (who didn't participate in the definition) that agree with it

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Practical disciplines

◆ Hands-on heuristics

- ◆ Both are practiced disciplines that depend on experience and judgement more than theory

◆ Too little "science"

- ◆ Computer science (mathematics and representations, defining abstract multi-dimensional algebras)
- ◆ General Systems Theory (systems thinking), operations research (statistics), Technical management (schedules and resources)

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No respect

- ◆ Unrecognized children of other disciplines
- ◆ SE first thing cut (after documentation)
- ◆ Everybody can program
- ◆ Communication issues; lack of "concreteness"



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Why are SE and SwE Rivals?

- ◆ Similarity
- ◆ Language
- ◆ Acknowledgement
- ◆ Blame



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Similarity breeds hubris

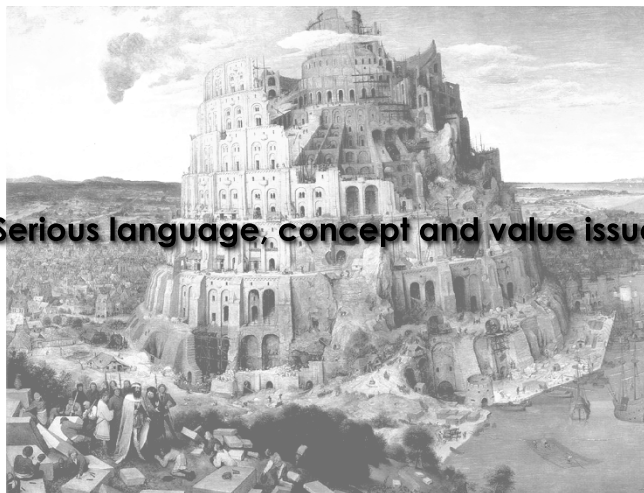


**That which makes them siblings
makes them rivals!**

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Siblings that speak different dialects

◆ **Serious language, concept and value issues**



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Competition for acknowledgement

- ◆ Often vying for reduced funding
- ◆ Both perceived as expenses rather than assets

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Poor results lead to finger pointing



DIFFERENCES



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Different backgrounds

- ◆ SE: "Hard engineers" of one sort or another
- ◆ SWE: Soft mathematicians and second careers

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SE Stereotypes



- ◆ White shirts and pocket protectors
- ◆ Boxes and arrows and piles of documentation
- ◆ Overhead slowing progress

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SwE stereotypes (bad)



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SwE stereotypes (Good?)



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Reconciliation is critical

- ◆ No need to create a new hybrid discipline
- ◆ Each discipline must learn from the other
 - ◆ Software engineers can embrace a broader systems view – particularly in cyber-physical systems
 - ◆ Systems engineers need to find ways to be more agile to be relevant in the rapidly changing environment

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So what do we do about it?

- ◆ **Research**
(SERC, Touchpoints, Cyber-Physical Systems)
- ◆ **Education**
(GSwERC, BKCASE)
- ◆ **Balancing**
(Incremental Commitment Model)
- ◆ **Transformation**
(Systems Engineering Transformation)

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Systems Engineering Research Center

- ◆ **A University Affiliated Research Center established in 2008 and sponsored by US DoD**
- ◆ **SE research supports development, integration, testing and sustainability of complex defense systems, enterprises and services**
- ◆ **Stevens Institute leads the 20 universities and research centers that make up SERC**
- ◆ **www.sercuarc.org**



Stevens' Main Campus, Hoboken, NJ

8/10/2009

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SERC research thrusts

- ◆ Enterprise Responsiveness
- ◆ Systems Science and Complexity
- ◆ Systems Engineering Workforce
- ◆ Program and SE Integration
- ◆ Life Cycle Systems Engineering Processes

SYSTEMS ENGINEERING
Research Center

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Pyster-Turner Touchpoints

- ◆ Simple framework for discussion of SE/SwE integration from practitioners POV
- ◆ Describes Touchpoints where the two disciplines interact, Faults and Resolution Strategies
- ◆ Faults can be a Gap, Waste or a Clash of Vocabulary, Value, or Mental Model

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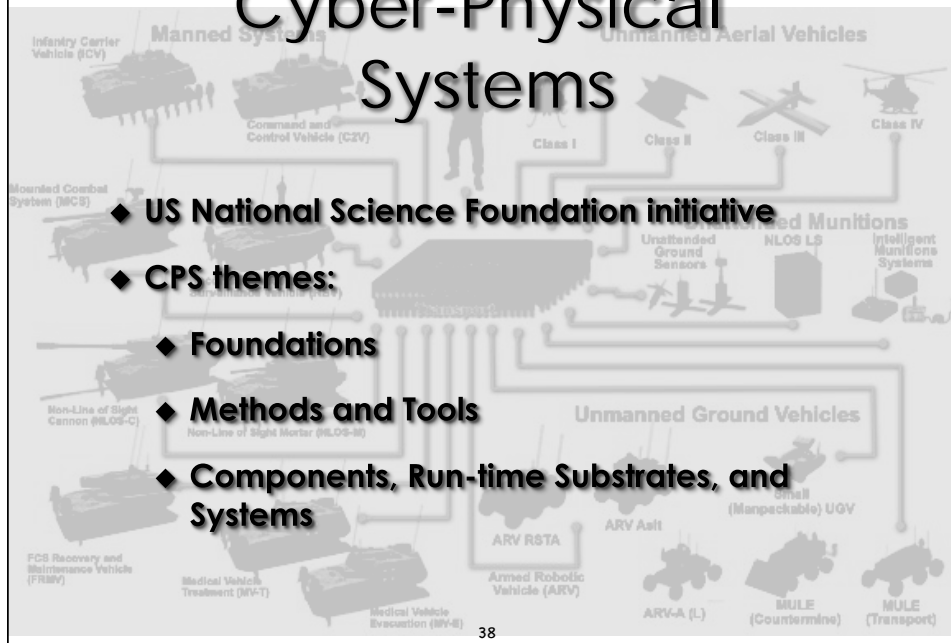
Example Touchpoint

Touchpoint	Fault	Type
Software Requirements	SW specifications that limit trade space	Clash – Mental Model

Resolution Strategies
SE defines software requirements as “what” not “how”
SE and SwE collaborate in to develop of SW requirements

Drawn from initial piloting with 10 varied US DoD programs

Cyber-Physical Systems



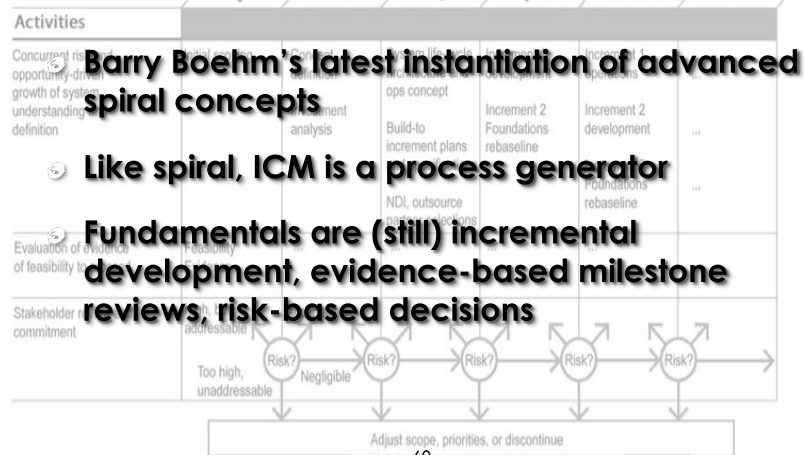
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GSwERC and BKCASE

- Graduate Software Engineering Reference Curriculum (www.gswerc.org)
- Body of Knowledge and Curriculum for Advanced Systems Engineering (proposed and waiting approval)

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Incremental Commitment Model



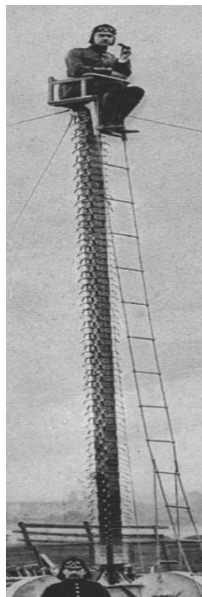
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Systems Engineering Transformation

- ⑤ **Proposed Systems Engineering Research Center (SERC) Project to rapidly evolve SE**
- ⑤ **SE for net-centric systems with dynamic requirements and technologies, short planning cycles and 21st c. workforce**
- ⑤ **Must be Agile, Integrated, Lean, Leveraged, Extensible, Implementable**
- ⑤ **Work begun with methods/processes/tools survey and research on agile CONOPS (survey found at www.sercuarc.org/AgileSE)**

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Some Final Observations



- ◆ **Interdependent systems are here to stay**
- ◆ **Complexity, criticality, collaboration, security, speed and human nature place increased pressure on systems and software engineering capabilities**
- ◆ **Reconciliation is needed: Each needs to learn from the other**
- ◆ **Progress is slow but accelerating with new research initiatives**

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Questions?

